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STRUCTURE DE VOILE À CAISSONS GONFLABLES ET DISPOSITIF DE MANOEUVRE SUR UN BATEAU MUNI D'UN MÂT

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SAIL STRUCTURE WITH INFLATABLE CHAMBERS AND MANEUVERING DEVICE ON A BOAT PROVIDED WITH A MAST

[Structure de voile à caissons gonflables et dispositif de manoeuvre sur un bateau muni d'un mât]

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The present invention relates to a sail structure for a ship and to a device for maneuvering this sail on a boat provided with a mast.

Known sailboats generally use sails guided either by the mast or by sets of ropes between certain parts of the ship and the mast. Adjustable sheets make it possible to tighten these sails to varying degrees and to orient them. Another type of sail is also used, called a spinnaker, during sailing with certain points of sailing. This very concave sail receives the wind essentially perpendicularly to its vertical median line. Its attachment to the ship is generally done at three points, the first at the upper part in the vertical median plane and the other two on either side of this median plane at the lower ends of the sail.

This sail is very difficult to manage, because on the one hand inflating is difficult, and on the other hand its orientation must be maintained perfectly perpendicular to the wind under threat of sudden deflation, leading to frequent and numerous adjustments. Such a sail can only be used for certain particular points of sailing called sailing downwind, during which the wind blows from the back to the front of the boat.

Boat sails are known from French Patent Application No. 2 564 618 that have an airfoil with automatic trim whose angle of incidence remains constant with respect to the axis of its movement relative to the fluid, regardless of the variations of movement of the fluid. In this case, it pertains to a rigid sail like an airplane wing mounted so as to pivot around the mast.

The British patent No. 2 151 199 describes a sealed thick sail inflated by introduction of a volume of air at constant pressure, with a symmetrical or concave profile of known triangular shape and attached to a boom. The profile of the sail is modified by variation of the internal pressure.

The present invention relates to a sail structure which is self-orienting with respect to the wind, which does not require any adjustment as a function of the force of the wind, and which is easy to use on boats of known type.

To this effect, the sail structure according to the invention, used in particular for propelling a ship provided with a mast, is characterized by the fact that it has a sail with juxtaposed inflatable chambers provided with an air intake and connected together by their lateral surfaces, at least two ropes, the first ends of which are the points of attachment on the sail behind the leading edge and on a single line, the second ends of which are attached respectively at the top of the mast and at the height of the deck, the trim of the sail being self-orienting with

respect to the apparent wind. Furthermore, according to another characteristic, the leading edge of the sail is essentially parallel to the longitudinal axis of the mast. According to another characteristic, the sail structure has a halyard coming from the upper end of the mast and attached to one of the lateral ends of the sail, and an adjustable tie attached to the other lateral end.

According to a particular characteristic of the invention, the sail structure also has a trailing edge which is curved from the intrados to extrados. The sail with the structure according to the invention is symmetrical so as to allow 180° pivoting of the sail with respect to the horizontal median plane perpendicular to the leading edge by reversal of the points of attachment of the halyard and the adjustable tie.

A sail structure if this type poses maneuvering problems when one wishes to haul it up or lower it and more particularly when one wishes to lower it partially for reefing. These thick sail structures, like all sails of known type, have two points of attachment at their ends, attached to both the upper chamber and lower chamber, the lower point intended for being attached to the hull of the boat, whereas the upper point is attached to the end of the mast halyard. When one wishes to haul up this thick sail, it is sufficient to exert traction on the mast halyard which causes the sail to rise.

In comparison with traditional sails, it is essential during this maneuver for the openings of the chambers to present themselves facing the wind and open in order to allow the inflation of the chambers. Now, if traction is exerted at the upper part of the sail on the end chamber by means of the halyard, the weight of the sail itself exerts traction towards the bottom which tends to pinch the opening and prevent inflation of the chambers. Moreover, in the case in which the sail is hauled up completely, a gust of wind can bring about a great concavity in the sail which is expressed by traction at the two points of attachment, on the mast halyard and on the boat, which leads again to pinching of the chambers and possibly to partial deflation of them. Such deflation is detrimental to the stiffness of the sail and to its proper functioning.

The present invention therefore also aims to remedy these disadvantages and to propose a device for maneuvering this thick sail which allows reefing without deflation of the chambers, adjustment of the concavity of the sail, which avoids any flapping of ropes outside of the sail, the inflation of which is facilitated during the hauling up and lowering maneuvers and which limits the drag which could be detrimental to the lift.

To this end, the maneuvering device on a boat provided with a mast and a mast halyard, according to the invention applicable to this thick sail of the type with juxtaposed inflatable chambers separated by ribs, has some first securing means connected with the two end chambers and is characterized by the fact that it has a length of rope longer than the height of the sail and which is provided at its two ends with a pulley-like means, a halyard with a closed loop, with

two strands, running through each of the pulley-like means, and which is provided with a second securing means intended for cooperating with the first securing means, attached to the chamber at the upper end, and by the fact that each of the ribs has at least one hole through which the length of rope runs in such a way that the sail hauled up or lowered by means of the halyard slides on this length of rope.

According to another characteristic of the invention, the device is characterized by the fact that the halyard also runs through the holes of the ribs parallel to the length of rope.

According to a variant, the device is characterized by the fact that each of the ribs has two additional holes for the passage of each of the two strands of the halyard.

According to another characteristic of the device, the pulley-like means at the ends of the length of rope are eyes in which the halyard slides.

Moreover, according to another characteristic of the invention, each chamber has a non-extensible component whose length is less than the height of a chamber, attached to the two ribs delimiting this chamber.

The invention will be described according to a particular embodiment with reference to the appended drawings in which:

Figure 1 represents a view of the back of a ship sailing large provided with a sail structure according to the invention,

Figure 2 represents a top view of the ship represented in Figure 1,

Figure 3 is a view of the ship sailing close-hauled,

Figure 4 is a view of the ship sailing before the wind provided with two sail structures according to the invention,

Figure 5 represents a diagrammatic of a boat provided with a mast and equipped with the device for maneuvering of the sail structure according to the invention,

Figure 6 is an oblique view of the maneuvering device according to the invention, and

Figure 7 represents a view in section through a vertical plane parallel to the openings of the chambers.

Figure 1 represents ship 10 which has mast 12, sail 14, halyard 16 and adjustable tie 18.

Ship 10 of the sailboat type has hull 20, keel 22, and deck 24. In a known manner, points of attachment of rigging 26 of mast 12 are provided on deck 24. Halyard 16 is also adjustable in terms of length from deck 24.

Sail 14 has inflatable chambers 28 provided with air intakes 30, juxtaposed together by their lateral surfaces in such a way as to form the same airfoil. On the lateral surfaces of the lateral chambers, two points of attachment 32 and 34 are provided for attachment respectively of halyard 16 and of adjustable tie 18. These points of attachment 32 and 34 are arranged on the same line parallel to the leading edge, behind it in the zone of greatest lift, and are adjustable in

terms of position between the leading edge and the trailing edge. The shape of sail 14 is essentially rectangular, the length of the leading edge corresponding essentially to the height of the mast.

The profile of the sail is special because its trailing edge is curved from the intrados to the extrados, as shown in more detail in Figure 2. This curvature of the trailing edge is obtained by cutting of the lateral sides of the chambers or of the ribs. Furthermore, the length of the extrados measured in the longitudinal direction of the chambers is greater than the length of intrados. The profile of the sail makes it self-orienting with respect to the apparent wind. The sail therefore orients itself with respect to the wind with a constant angle.

In Figure 2, the ship is moving in the direction of arrow 36, while the wind comes to it from the left side perpendicularly according to arrow 38, which corresponds to sailing large. The plane passing through adjustable tie 18 and halyard 16 makes an angle with the direction of the wind, this angle being therefore a function of the profile of the sail, and the pulling force is exerted according to arrow 40.

Represented in Figure 3 is the ship sailing with a different point of sailing called close-hauled, that is to say when the direction of movement 36 of the ship makes an acute angle with direction 38 of the wind. The pulling force is then exerted according to arrow 40 since the sail has a constant position with respect to the direction of the wind.

In the case of a wind blowing on the right side of the ship, it is necessary to bring the sail onto the deck in order to have it pivot 180°, this time connecting halyard 16 to point of attachment 34, while sheet 18 is connected at point of attachment 32. The sail can thus function in the same manner as that just described in the preceding with a wind blowing on the other tack.

The inflation of the sail structure according to the invention is done simply by hauling the sail up my means of halyard 16; the chambers then gradually inflate as they rise until the leading edge is essentially parallel to the mast. As a function of the force of the wind and the inclination assumed by the mast, it is possible to adjust the sail by means of adjustable tie 18 in such a way that the leading edge remains essentially perpendicular to the direction of the wind. Such an adjustment makes it possible to optimize the functioning of the sail, with it being possible nevertheless for the sail to support great shifts of orientation of the leading edge while continuing to function.

In the case of a tailwind as represented in Figure 4, the ship can be provided with two sail structures according to the invention, on both sides of its direction of movement and arranged symmetrically with respect to this direction.

Variants can be provided for sail 14; thus, its rectangular sail layout can take the shape of a V, points of attachment 32 and 34 being then situated at the ends of the limbs of the V, or else an A shape.

Likewise, at the trailing edge, the chambers are closed, but it is possible to provide an air outlet whose cross section would be smaller than the cross section of the air intake of the chambers. A useful precaution for this type of sail consists of having screens on the air intakes so as to prevent any penetration of solid foreign bodies into said chambers.

Represented in Figure 5 is boat 110 with hull 112 provided with keel 114 and mast 116. Mast 116 in a known manner has mast halyard 118 intended for hauling up or lowering the sails. Maneuvering device 120 for thick sail 122 is diagrammatically represented in this same Figure 5.

Maneuvering device 120 is represented in detail in Figure 6. This maneuvering device has length of rope 124 provided with two eyes, upper eye 126 and lower eye 128, as well as halyard 130 with two strands 131 and 133 in a closed loop; splice 132 of the ends of this halyard forms eye 134. Thick sail 122 has a number of chambers 136 juxtaposed with respect to one another and separated by ribs 138. The profile of the sail which is represented is called auto-flying, that is self-orienting with respect to the wind as described above.

In Figure 6, the sail is in the processes of being hauled up or lowered, and part 140 corresponds to the folded part of the sail. Each chamber has front opening 142 which is more particularly provided on the leading edge of the thick sail. Each of chambers 136 situated at the upper end and lower end of the sail has snap hook 144 and 146, attached more particularly on ribs 138.

Each of ribs 138 has three holes 148, 150 and 152 through which strands 131 and 133 of halyard 130 and length of rope 124 run.

The assembly is completed by two snap hooks 154 and 156 intended for attaching the ends of the length of rope on hull 112, on the one hand, and on mast halyard 118 on the other hand.

As shown by Figure 7, sail 122 is completed by non-extensible component 158 of the unidirectional fabric type arranged over the whole height of the sail and attached to each of the ribs. This component 158 has a length equal to the length of the chord subtending curved portion 160 of the intrados of each of the inflated chambers.

The functioning of this maneuvering device is described in the in the following.

Eye 126 of the upper end of the length of rope is attached to snap hook 156 of mast halyard 118. This halyard is maneuvered so as to haul up length of rope 124 causing it to tighten, eye 128 at the lower part of the length of rope having been attached beforehand to snap hook 154 connected with hull 112 of the boat. Sail 122 is therefore accordion-folded along length of rope 124 at the bottom of the rope. Lower snap hook 146 connected with the lower chamber of sail 122 is also attached to the boat either directly in snap hook 154 or by means of an additional rope, as represented in Figure 6, so that the position in terms of height of the inflated sail can be adjusted.

Snap hook 144 connected with the chamber at the upper end of sail 122 is attached to eye 134 provided on halyard 130.

By pulling in the direction of arrow 122 [sic; 162] on strand 131 of halyard 130, the user causes strand 133 to move in the opposite direction. In rising, eye 134 on this strand 133 carries along the first chamber of sail 122 by means of snap hook 144. When the first chamber 136 is inflated, non-extensible component 158 between the first two ribs of the first chamber is taut. The part of non-extensible component 158 of the second chamber is then pulled until it also becomes taut, allowing inflation of the second chamber. This maneuver is then repeated until all of the chambers are completely inflated and the sail is completely hauled up. The whole non-extensible component 158 is then taut, and the tensile forces exerted on snap hooks 144 and 146 are transferred directly to this component. The user then has the possibility of adjusting the concavity of the sail by applying varying amounts of tension on halyard 118.

Likewise, it is possible to adjust the sail area exposed to the wind by reefing in the same manner as on a conventional sail. In this case, it is sufficient to lower the sail the desired number of chambers and to ensure the connection of the lowermost inflated chamber with snap hook 154 or more generally with hull 112 so that it is possible to exert tension by means of strand 131 of halyard 130, this force being taken up by the part of non-extensible component 158 corresponding to the spread sail length. To this effect, it is possible to provide a loop on the non-extensible component in each of the chambers.

This maneuvering device allows any possibility of self-orientation of the sail according to its profile and as a function of the direction of the wind. Moreover, each chamber remains completely inflated since openings 142 do not undergo any pinching due to the pulling forces, which are taken up by non-extensible component 158.

This maneuvering device is suitable regardless of the height of the mast seeing that it allows reefing of the sail, that length of rope 124 can be reduced in length at any time, and that it can be shorter than the height of the mast, since the halyard compensates for the lack of height.

The maneuvering device for the sail structure according to the invention can have numerous variants.

Thus, according to a first variant, length of rope 124 has a pulley attached at each of its two ends in order to facilitate circulation of halyard 130. In certain large sail types, the pulley device can reduce friction and facilitate the hauling up and lowering maneuvers.

Likewise, according to another variant the two strands 131 and 133 of halyard 130 can run parallel to length of rope 124 in a single hole made in each of ribs 138 of chambers 136.

According to yet another variant, the halyard can be outside the sail, and each chamber can have a securing means attached on the intrados to facilitate reefing.

Claims

1. A sail structure, used in particular for propelling a boat provided with mast (12), characterized by the fact that it has sail (14) with juxtaposed inflatable chambers (28) provided with air intake and connected together by their lateral surfaces, at least two ropes (16, 18), the first ends of which are attached to said sail behind the leading edge on a single line and the second ends of which are attached respectively at the top of the mast and at the height of the deck, the trim of the sail being self-orienting with respect to the wind.

2. A sail structure according to Claim 1, characterized by the fact that one (16) of the two ropes is the mast halyard allowing the hauling up of the sail, and the other is an adjustable tie.

3. A sail structure according to Claim 1 or 2, characterized by the fact that the length of the leading edge of sail (14) is essentially equal to the height of the mast.

4. A structure according to any one of the preceding claims, characterized by the fact that sail (14) is attached to halyard (16) and to adjustable tie (18) in the vicinity of the lateral surfaces of lateral chambers (28) of said sail.

5. A structure according to any one of the preceding claims, characterized by the fact that adjustable tie (18) is provided so that its length can be adjusted and so as to keep the leading edge of sail (14) essentially perpendicular to the direction of the wind.

6. A structure according to any one of the preceding claims, characterized by the fact that according to the longitudinal axis of the chambers, the intrados is shorter than the extrados.

7. A structure according to any one of the preceding claims, characterized by the fact that the trailing edge is curved from the intrados to the extrados.

8. A structure according to any one of the preceding claims, characterized by the fact that sail (14) is symmetrical.

9. A structure according to any one of the preceding claims, characterized by the fact that the profile is in the shape of a V.

10. A structure according to any one of Claims 1-8, characterized by the fact that the sail layout is in the shape of an A.

11. A structure according to any one of the preceding claims, characterized by the fact that chambers (28) are provided with air outlets arranged at the level of the trailing edge, the cross section being smaller than the intake cross section.

12. A maneuvering device (120) on boat (112) for a thick sail structure (122) with inflatable chambers (136) separated by ribs (138) according to any one of the preceding claims, which has mast halyard (118) and some first securing means (144 and 146) connected with the two end chambers, characterized by the fact that it has length of rope (124) longer than the height of the sail and which is provided at its two ends with a pulley-like means, halyard (130) in a closed loop with two strands (131 and 133) running through each of the pulley-like means, and

which is provided with second securing means (134) intended for cooperating with first securing means (144), attached to the chamber at the upper end, and by the fact that each of ribs (138) has at least one hole (152) through which the length of rope runs in such a way that the sail hauled up or lowered by means of the halyard slides on this length of rope.

13. A device according to Claim 12, characterized by the fact that halyard (130) runs through holes (152) of the ribs parallel to the length of rope.

14. A device according to Claim 12, characterized by the fact that each of ribs (138) has two additional holes (148 and 150) for the passage of each of the two strands (131 and 133) of halyard (130).

15. A device according to any one of Claims 12-14, characterized by the fact that first securing means (134 and 146) are snap hooks, and second securing means (134) is an eye made in the splice of the ends of the halyard.

16. A device according to any one of Claims 12-15, characterized by the fact that the pulley-like means at the ends of length of rope (124) are eyes in which the halyard slides.

17. A device according to any one of Claims 12 to 16, characterized by the fact that each chamber (136) has non-extensible component (158), whose length is equal to the length of the chord subtending intrados (160) of an inflated chamber, which is attached to the two ribs delimiting this chamber.

18. A device according to Claim 17, characterized by the fact that non-extensible component (158) is a strip of fabric with unidirectional strength.

19. A device according to any one of Claims 12-18, characterized by the fact that non-extensible component (158) is attached at its ends to first securing means (144 and 146) of the sail.

20. A device according to any one of Claims 12 to 19, characterized by the fact that the upper end and the lower end of length of rope (124) are respectively hooked to mast halyard (118) and on hull (112) of the boat in such a way that it is possible to tighten this length of rope.

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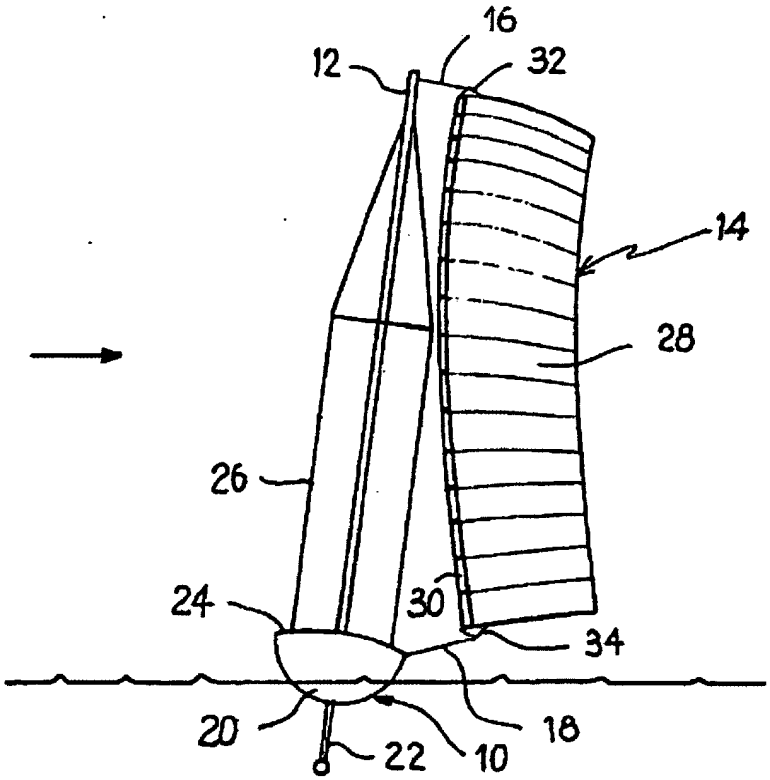

FIG. 1

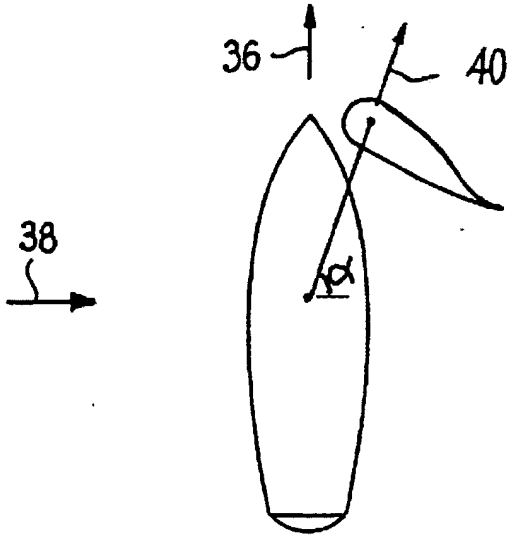

FIG. 2

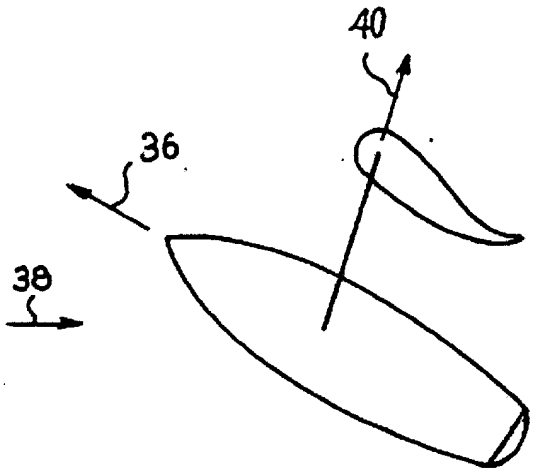

FIG. 3

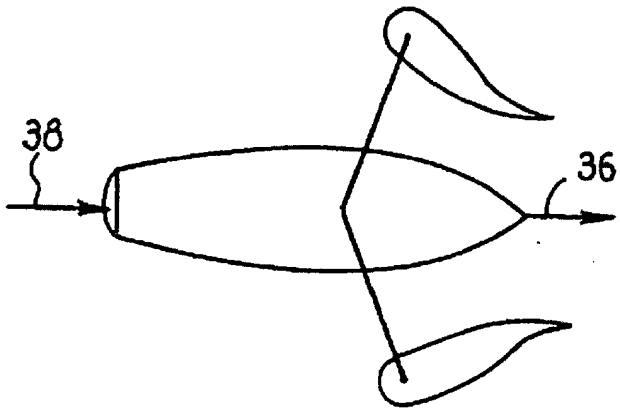

FIG. 4

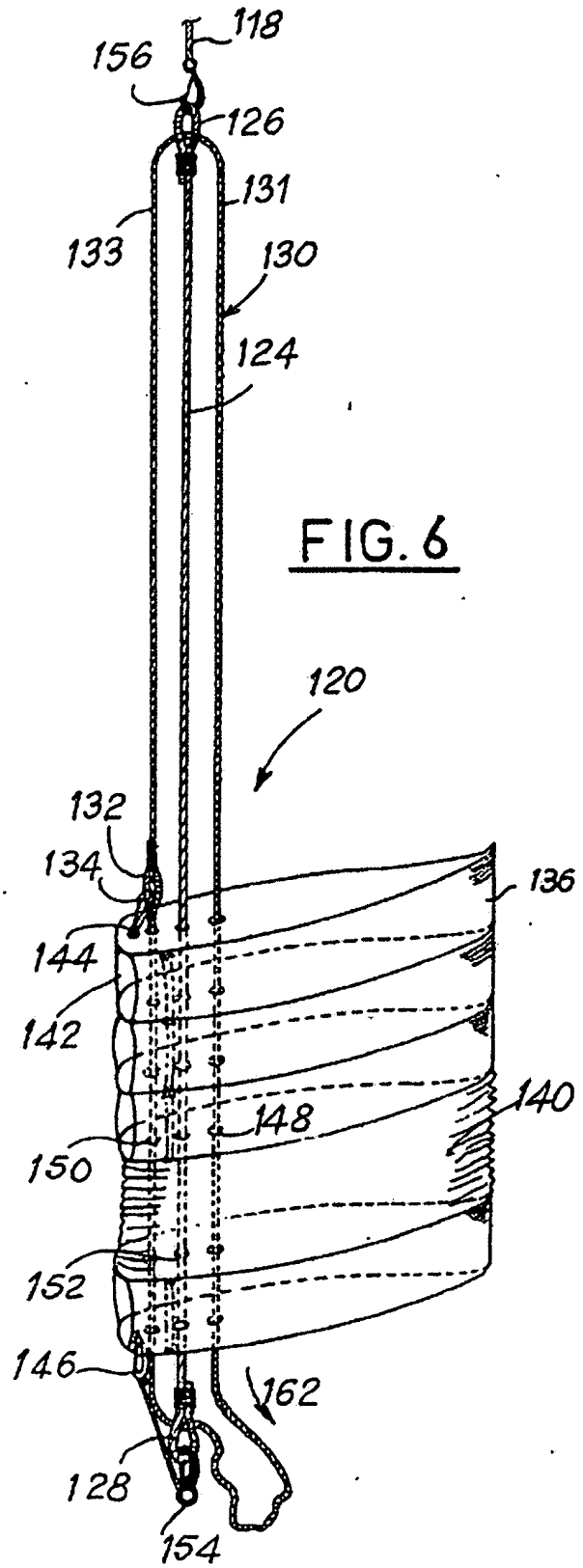

FIG. 6

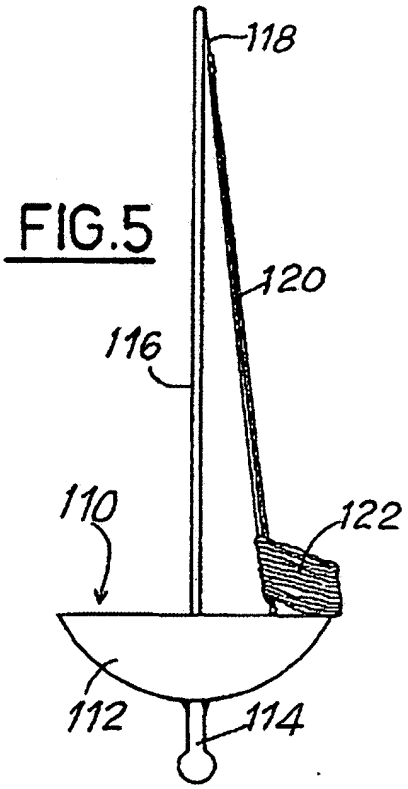

FIG. 5

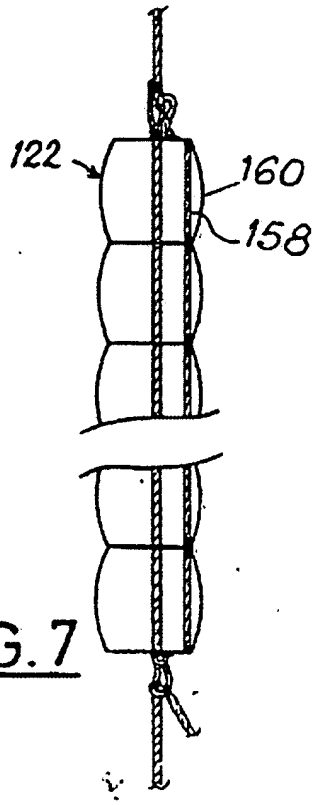

FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/FR 89/00606

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.5 B 63 H 9/06

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
Int. Cl.5	B 63 H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No. 13
A	US, A, 4497272 (VEAZEY) 5 February 1985, see column 1, lines 49-52; column 3, lines 26-57 --	1
A	GB, A, 2151199 (ZODIAC SA) 17 July 1985, see page 1, lines 69-116; page 2, lines 12-121; page 3, lines 1-42 --	1-5,8,9,12-14,17,19,20
A	WO, A, 86/00591 (GRAVELINE) 30 Janaury 1986, see page 3 - page 5, line 21 --	1,2,3,8,12, 13,14,17, 18,20
A	Patent Abstracts of Japan, volume 7, Nr. 50 (M-197)(1195), 26 February 1983, & JP, A, 57198194 (NIPPON KOKAN K.K.) 4 December 1982, see the abstract --	1,3,4,8,12, 17,18,20
A	FR, A, 2275360 (MAHIEUX) 16 Janaury 1976, see page 4, line 7 - page 6, line 3	2,3,8,12

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
2 March 1990 (02.03.90)	2 April 1990 (02.04.90)
International Searching Authority	**Signature of Authorized Officer**
European Patent Office	

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. FR 8900606 SA 32837

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 19/03/90 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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GB-A- 2151199	17-07-85	FR-A,B 2556310	14-06-85
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WO-A- 8600591	30-01-86	FR-A,B 2567098	10-01-86
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		EP-A- 0224482	10-06-87
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		US-A- 4757779	19-07-88
FR-A- 2275360	16-01-76	None	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82